

Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan

Agreement Commitment Report
1991



Chesapeake Bay Program

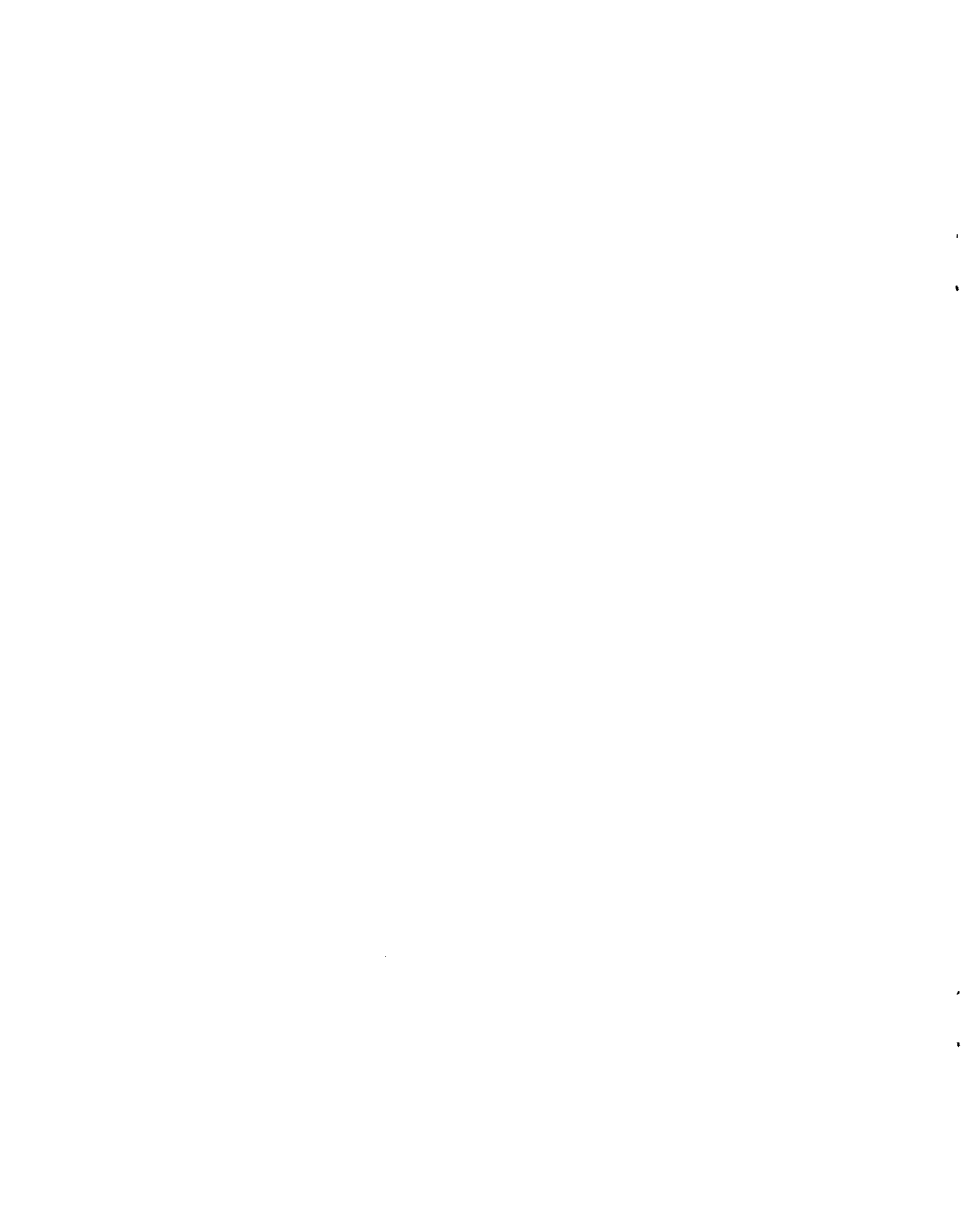


Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan

Chesapeake Bay Program

Agreement Commitment Report 1991

Produced under contract to the U.S. Environmental Protection Agency
Contract No. 68-WO-0043



ADOPTION STATEMENT

We, the undersigned, adopt the Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan in partial fulfillment of Living Resources Commitment Number 4 of the 1987 Chesapeake Bay Agreement:

“ . . . by July to develop, adopt, and begin to implement a Bay-wide management plan of oysters, blue crabs, and American Shad. Plans for the other major commercially, recreationally and ecologically valuable species should be initiated by 1990.”

The Atlantic Croaker and Spot were designated valuable species in the Schedule for Developing Baywide Resource Management Strategies. In 1991, the Atlantic Croaker and Spot plan was completed.

We agree to accept the plan as a guide to managing the Atlantic Croaker and Spot stock in the Chesapeake Bay and its tributaries for optimum ecological, social and economic benefits. We further agree to work together to implement, by the dates set forth in the plan, management actions recommended to monitor the status of the stocks, obtain catch and effort information from the bait fishery, address research and monitoring needs, and develop the habitat and water quality criteria necessary for healthy Atlantic Croaker and Spot populations.

We recognize the need to commit long-term, stable, financial support and human resources to the task of managing the Atlantic Croaker and Spot stock. In addition, we direct the Living Resources Subcommittee to periodically review and update the plan and report on progress made in achieving the plan's management recommendations.

Date December 18, 1992

For the Commonwealth of Virginia

Lawrence Douglas Miller

For the State of Maryland

Dillon Paul Doherty

For the Commonwealth of Pennsylvania

Robert P. Casey

For the United States of America

William K. Kelly

For the District of Columbia

John Pratt Kelly

For the Chesapeake Bay Commission

Bernie Jolley

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	iv
INTRODUCTION.....	vii
SECTION 1. Biological Background.....	1
Life History - Atlantic Croaker.....	1
Biological Profile - Atlantic Croaker.....	2
Life History - Spot.....	3
Biological Profile - Spot.....	4
The Fishery - Atlantic Croaker.....	5
Fishery Parameters - Atlantic Croaker.....	10
The Fishery - Spot.....	10
Fishery Parameters - Spot.....	13
Economic Perspective.....	13
Habitat Issues.....	17
FMP Status and Management Unit.....	17
Resource Status - Atlantic Croaker.....	18
Resource Status - Spot.....	18
Laws and Regulations.....	18
Status of Traditional Fishery Management Approaches....	20
Data and Analytical Needs.....	23
References.....	23
SECTION 2. Atlantic Croaker and Spot Management.....	27
A. Goal and Objectives.....	27
B. Problem Areas and Management Strategies.....	28
1. Stock Status.....	28
2. Harvest of small Croaker and Spot.....	29
3. Research and Monitoring Needs.....	30
4. Habitat and Water Quality Issues.....	31
APPENDIX: Atlantic Croaker and Spot Implementation Matrix...	33

Figures

1. Croaker commercial landings from the Atlantic coast....	6
2a. Commercial landings for Atlantic Croaker from the Chesapeake Bay.....	7
2b. Maryland commercial landings for Atlantic Croaker.....	7
2c. Virginia commercial landings for Atlantic Croaker.....	7
3. Atlantic Croaker caught by recreational anglers, Mid-Atlantic.....	9
4. Spot commercial landings from the Atlantic Coast.....	11
5a. Commercial landings for spot from the Chesapeake Bay...	12
5b. Maryland commercial landings for Spot.....	12

5c.	Virginia commercial landings for Spot.....	12
6.	Spot caught by recreational anglers, Mid-Atlantic region.....	14
7.	Spot caught by the commercial fishery, Mid-Atlantic region.....	14
8.	Maryland dockside value for croaker.....	15
9.	Maryland dockside value for spot.....	15
10.	Virginia dockside value for Atlantic croaker.....	16
11.	Virginia dockside value for spot.....	16

ACKNOWLEDGEMENTS

The Chesapeake Bay Atlantic Croaker and Spot Management Plan was developed under the direction of the Fisheries Management Workgroup. Staff from the Maryland Department of Natural Resources (MDNR), Tidewater Administration, Fisheries Division were responsible for writing the plan and addressing comments on the draft versions. Support was provided by staff from the Virginia Marine Resources Commission (VMRC), Fisheries Management Division. Contributing MDNR staff included Nancy Butowski and Harley Speir. VMRC staff included David Boyd, Roy Insley, Sonya Knur, and Ellen Smoller. Thanks are due to Verna Harrison and Ed Christoffers for guiding the plan through the development and adoption process. Carin Bisland, from EPA's Chesapeake Bay Liaison Office, assisted with production of title pages and fact sheets, and with printing and distribution. Finally, we express gratitude to members of other Chesapeake Bay Program committees and workgroups and to the public who commented on the plan.

Members of the Fisheries Management Workgroup were:

Mr. Mark Bundy, STAC Economic Advisory Group
Mr. K.A. Carpenter, Potomac River Fisheries Commission
Mr. Jeffrey S. Eutsler, Maryland Waterman
Mr. William Goldsborough, Chesapeake Bay Foundation
Mr. J. W. Gunther, Jr., Virginia Waterman
Mr. Robert Hesser, Pennsylvania Fish Commission
Dr. Edward Houde, UMCEES/Chesapeake Biological Laboratory
Ms. Linda Hurley, USFWS Bay Program
Mr. W. Pete Jensen, Chair, MD Department of Natural Resources
Dr. Roman Jesien, Horn Point Environmental Lab
Mr. J. Claiborne Jones, Chesapeake Bay Commission
Dr. Ron Klauda, MDNR, Chesapeake Bay Research and Monitoring
Dr. Robert Lippson, NOAA/National Marine Fisheries Service
Dr. Charles F. Lovell, Jr., M.D., Virginia
Mr. Richard Novotny, Maryland Saltwater Sportfishermen's Assoc.
Mr. Ed O'Brien, MD Charter Boat Association
Mr. Ira Palmer, D.C. Department of Consumer & Regulatory Affairs
Mr. James W. Sheffield, Atlantic Coast Conservation Assoc. of Va.
Mr. Larry Simms, MD Watermen's Association
Mr. Jack Travelstead, Virginia Marine Resources Commission
Ms. Mary Roe Walkup, Citizen's Advisory Committee

EXECUTIVE SUMMARY

Introduction

One of the strategies for implementing the Living Resources Commitments of the 1987 Chesapeake Bay Agreement is to develop and adopt a series of baywide fishery management plans (FMPs) for commercially, recreationally, and selected ecologically valuable species. The FMPs are to be implemented by the Commonwealth of Pennsylvania, Commonwealth of Virginia, District of Columbia, Potomac River Fisheries Commission, and State of Maryland as appropriate. Under a timetable adopted for completing management plans for several important species, the Atlantic Croaker and Spot FMP was scheduled for completion in December 1991.

A comprehensive approach to managing Chesapeake Bay fisheries is needed because biological, physical, economic, and social aspects of the fisheries are shared among the Bay's jurisdictions. The Chesapeake Bay Program's Living Resources Subcommittee formed a Fisheries Management Workgroup to address the commitment in the Bay Agreement for comprehensive, baywide fishery management plans. The workgroup is composed of members from government agencies, the academic community, the fishing industry, and public interest groups representing the District of Columbia, Maryland, Pennsylvania, Virginia, and the federal government.

Development of Fishery Management Plans

An FMP prepared under the 1987 Chesapeake Bay Agreement serves as a framework for conserving and wisely using a fishery resource of the Bay. Each management plan contains a summary of the fishery under consideration, a discussion of problems and issues that have arisen, and recommended management actions. An implementation plan is included at the end of the FMP to provide additional details on the actions that participating jurisdictions will take and the mechanisms for taking these actions.

Development of a fishery management plan is a dynamic process. The process starts with initial input by the Fishery Management Workgroup, is followed by public and scientific review of the management proposals, and then by endorsement by the appropriate Chesapeake Bay Program committees. A management plan is adopted when it is signed by the Chesapeake Bay Program's Executive Committee. In some cases, regulatory and legislative action will have to be initiated, while in others, additional funding and staffing may be required to fully implement a management action. A periodic review of each FMP is conducted under the auspices of the Bay Program's Living Resources Subcommittee, to incorporate new information and to update management strategies as needed.

Goal of the Atlantic Croaker and Spot Management Plan

The goal of the Chesapeake Bay Atlantic Croaker and Spot Management Plan is to protect the croaker and spot resource in the Chesapeake Bay, its tributaries, and coastal waters, while providing the greatest long-term ecological, economic, and social benefits from their usage over time.

In order to meet this goal, a number of objectives must be met. These objectives are incorporated into the problem areas and management strategies discussed below.

Problem Areas and Management Strategies

Problem 1: Stock Status. Recent commercial landings of Atlantic croaker have been approximately half of the historical landings. Although effort data is lacking, the decline in catch most likely represents a real decrease in abundance. Spot landings have been highly variable from year-to-year. Fluctuations in croaker and spot landings may be related to environmental factors, changes in fishing effort, and the degradation of estuarine habitats. Fishing is generally directed at one year class and yield per recruit has not been maximized.

Strategy 1: Stock Status. The jurisdictions will continue to monitor the Atlantic croaker and spot populations in the Bay and cooperate with the Atlantic States Marine Fisheries Commission to manage stocks along the coast. Increases in yield per recruit will be promoted.

Problem 2: Harvest of Small Croaker and Spot. The magnitude of the scrap catch, incidental bycatch and discard mortality of small croaker and spot has not been determined in the Chesapeake Bay but may significantly impact croaker and spot stocks.

Strategy 2: Harvest of Small Croaker and Spot. The jurisdictions will reduce the harvest of small croaker and spot in the directed and non-directed fisheries by promoting bycatch reduction devices (BRDs) in the southern shrimp fishery and the use of fish separators in the finfish trawl fishery. Each jurisdiction will continue its minimum mesh size restrictions for gill netting as a means of reducing bycatch.

Problem 3: Research and Monitoring Needs: There is a lack of stock assessment data and socioeconomic information for both the Atlantic croaker and spot stocks in the Chesapeake Bay and along the Atlantic coast. Information on recruitment, age, size, sex composition, and migratory patterns along the coast is lacking. Improved catch and effort data are needed from the recreational and commercial fisheries to assess the impact of fishing activities.

Strategy 3: Research and Monitoring Needs. The jurisdictions will promote research on the biology and socioeconomic factors that affect croaker and spot stocks in the Chesapeake Bay.

Problem 4: Habitat and Water Quality Issues. Atlantic croaker and spot are dependent on the Chesapeake Bay for nursery grounds. Habitat alterations within the Bay affect croaker and spot stocks. Low dissolved oxygen limits their distribution through behavioral avoidance of areas with stressful oxygen concentrations and by limiting their prey distribution.

Strategy 4 Habitat and Water Quality Issues: The jurisdictions will continue their efforts to improve water quality and define habitat requirements for living resources in the Bay. Efforts include identifying and controlling nutrients, toxic materials, conventional pollutants, and atmospheric inputs; protecting wetlands and submerged aquatic vegetation; and managing population growth.

INTRODUCTION

MANAGEMENT PLAN BACKGROUND

As part of the 1987 Chesapeake Bay Agreement's commitment to protect and manage the natural resources of the Chesapeake Bay, the Bay jurisdictions are developing a series of fishery management plans covering commercially, recreationally, and selected ecologically valuable species. Under the agreement's Schedule for Developing Baywide Resource Management Strategies, a list of priority species was formulated, with a timetable for completing fishery management plans as follows:

- oysters, blue crabs and American shad by July 1989;
- striped bass, bluefish, weakfish and spotted seatrout by 1990;
- croaker, spot, summer flounder and American eel by 1991;
- red and black drum by 1992; and
- Spanish and king mackerel, tautog, black sea bass and freshwater catfish by 1993.

A comprehensive and coordinated approach by the various local, state and federal groups in the Chesapeake Bay watershed is central to successful fishery management. Bay fisheries are traditionally managed separately by Pennsylvania, Maryland, Virginia, the District of Columbia, and the Potomac River Fisheries Commission. There is also a federal Mid-Atlantic Fishery Management Council, which has management jurisdiction for offshore fisheries (3-200 miles), and a coastwide organization, the Atlantic States Marine Fisheries Commission (ASMFC), which coordinates the management of migratory species in state waters (internal waters to 3 miles offshore) from Maine to Florida. The state/federal Chesapeake Bay Stock Assessment Committee (CBSAC) is responsible for developing a Baywide Stock Assessment Plan, which includes collection and analysis of fisheries information, but does not include the development of fishery management plans.

Consequently, a Fisheries Management Workgroup, under the auspices of the Chesapeake Bay Program's Living Resources Subcommittee, was formed to address the commitment in the Bay Agreement for baywide fishery management plans. The Fisheries Management Workgroup is responsible for developing fishery management plans with a broad-based view. The workgroup's members represent fishery management agencies from the District of Columbia, Maryland, Pennsylvania, the Potomac River Fisheries Commission, Virginia, and the federal government; the Bay area academic community; the fishing industry; conservation groups; and interested citizens. Establishing Chesapeake Bay FMPs, in addition to coastal FMPs, creates a forum to specifically address problems that are unique to the Chesapeake Bay. They also serve as the basis for implementing regulations in the Bay jurisdictions.

WHAT IS A FISHERY MANAGEMENT PLAN?

A Chesapeake Bay fishery management plan provides a framework for the Bay jurisdictions to take compatible, coordinated management measures to conserve and utilize a fishery resource. A management plan includes pertinent background information, lists management actions that need to be taken, the jurisdictions responsible for implementation, and an implementation timetable.

A fishery management plan is not an endpoint in the management of a fishery; rather, it is part of a dynamic, ongoing process consisting of several steps. The first step consists of analyzing the complex biological, economic and social aspects of a particular finfish or shellfish fishery. The second step includes defining a fishery's problems, identifying potential solutions, and choosing appropriate management strategies. Next, the chosen management strategies are put into action or implemented. Finally, a plan must be regularly reviewed and updated in order to respond to the most current information on the fishery; this requires that a management plan be adaptive and flexible.

GOALS AND OBJECTIVES FOR FISHERY MANAGEMENT PLANS

The goal of fisheries management is to protect the reproductive capability of the resource while providing for its optimal use by man. Fisheries management must include biological, economic and social considerations in order to be effective. Three simply stated objectives to achieve this goal are:

- o quantify biologically appropriate levels of harvest;
- o monitor current and future resource status to ensure harvest levels are conserving the species while maintaining an economically viable fishery; and
- o adjust resource use and other factors affecting resource status, as needed, through management efforts.

These general objectives are incorporated with information on a particular resource and the current status of management for that resource, into specific objectives for a fishery management plan.

MANAGEMENT PLAN FORMAT

The background section of this management plan summarizes:

- o life history and biological profile for each species;
- o Atlantic croaker and spot fisheries and fishery parameters;
- o economic perspective;

- resource status;
- habitat issues;
- FMP status and management unit;
- Current laws and regulations in the Chesapeake Bay; and
- data and analytical needs.

The background information is partially derived from the document entitled, Chesapeake Bay Fisheries: Status, Trends, Priorities and Data Needs and is supplemented with additional data. Inclusion of this section as part of the management plan provides historical background and basic biological information for each of the species.

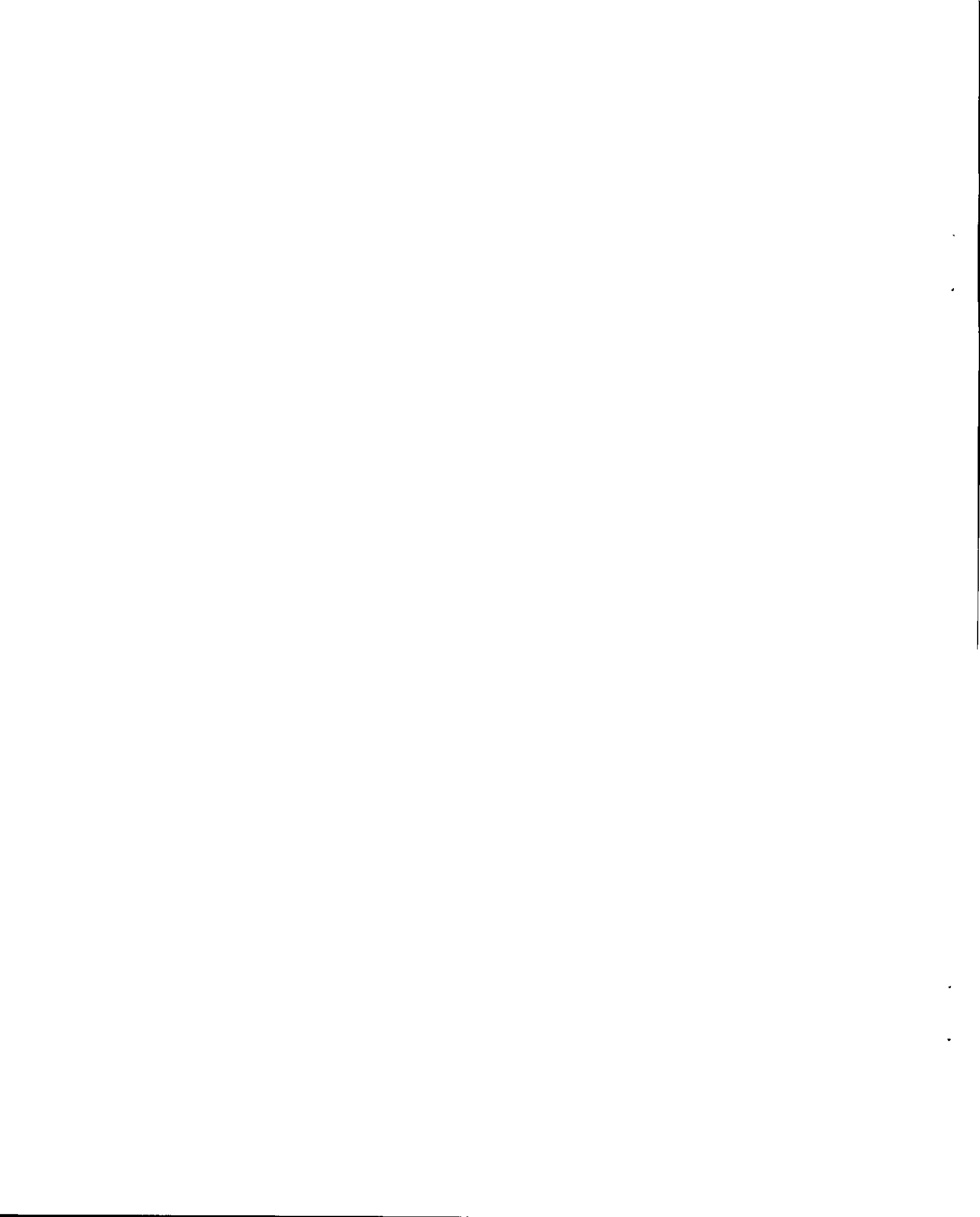
The management section of the plan, which follows the background, defines:

- the goal and objectives for management of the species;
- problem areas;
- management strategies to address each problem area; and
- action items, with a schedule for implementation, by the appropriate management agency.

THE CHESAPEAKE BAY PROGRAM'S FISHERY MANAGEMENT PLANNING PROCESS

The planning process starts with initial input by the Fisheries Management Workgroup and development of a draft plan. This is followed by a review of the management proposals by Bay Program committees, other scientists and resource managers, and the public. After a revised draft management plan is prepared, it must be endorsed by the Chesapeake Bay Program's Living Resources Subcommittee and Implementation and Principal Staff committees. The plan is then sent to the Executive Committee for adoption.

Upon adoption by the Executive Committee, the appropriate management agencies implement the plan. In 1990, the Maryland legislature approved §4-215 of the Natural Resource Article giving the Maryland Department of Natural Resources authority to regulate a fishery once a FMP has been adopted by regulation. In Virginia, FMP recommendations are pursued either by legislative changes or through a public regulatory process conducted by the Commission. A periodic review of each FMP is conducted by the Fisheries Management Workgroup to incorporate new information and to update management strategies as needed.



Section 1. Biological Background

The Atlantic croaker (Micropogonias undulatus) and spot (Leiostomus xanthurus) belong to the family of fishes called Sciaenidae. Members of this family comprise an important inshore bottom fishery resource along the Atlantic coast (Cowan and Birdsong 1985). The croakers and drums characteristically produce a drumming sound by vibrating their swim bladder with special muscles.

Life History - Atlantic Croaker

The Atlantic croaker can be found along the coast from Cape Cod, Massachusetts to Campeche Bank, Mexico (Welsh and Breder 1923). It is one of the most abundant inshore fish species, especially in the southeast Atlantic and northern Gulf of Mexico (Chittenden and McEachran 1976). Croaker are also known by the common name, hardhead. Differences in life history patterns have been noted between croaker populations found north and south of Cape Hatteras, North Carolina. Generally, northern populations spawn earlier in the season, reach maturity later, are larger in size, and live longer than southern populations (White and Chittenden 1977). The differences between populations have been attributed to dissimilar temperature conditions and not to genetic origin.

Adult croaker generally spend the spring and summer in estuaries and move offshore and south along the Atlantic coast in the fall. In the Chesapeake Bay, croaker migrate up-river and up-bay in the spring, randomly move around during the summer, and then swim down-river and down-bay in the fall (Haven 1957). Adult croaker can be found in the Bay from March to October, with peak abundance from May through August (Stagg 1986). Mature croaker spawn over shelf waters during an extended fall-winter spawning season. Fecundity, number of eggs per female, ranges from 100,800 to 1,742,000 eggs/female for fish 196 to 390 mm TL (7.7-15.4 inches TL) (Morse 1980). Size and age at maturity vary according to location. Female croaker from Chesapeake Bay generally reach maturity at age III while 45% of male croaker reach maturity at age II (Wallace 1940). Length at which 50% of the fish are mature has been calculated by Morse (1980) and ranges from 185 mm TL to 233 mm TL (7.3-9.2 inches TL).

The fall-winter spawning period can begin as early as September and continue through December. It occurs over a broad area and includes the mouth of the Chesapeake Bay (Haven 1957). Young-of-the-year croaker have been collected in coastal estuaries off the Virginia coast from October to February (Cowan and Birdsong 1985). They are known to move into the York River in May (Chao and Musick 1977). Juvenile croaker prefer low salinity habitats and

open-water rather than submerged vegetation areas. Immature croaker stay in the Bay until the water temperature decreases in late summer and fall, then migrate to coastal areas.

Atlantic croaker are opportunistic bottom-feeders that consume a variety of invertebrates and occasionally fish. They prefer muddy bottoms and generally inhabit depths less than 120 m. They are considered a euryhaline species and have been collected coastwide in salinities between 0 and 75 o/oo. Adults have been collected from water temperatures between 10°C and 34°C (50-93°F). Maximum life span reported for croaker is 8 years. Predators of croaker include striped bass, flounder, shark, spotted seatrout, croaker, bluefish, and weakfish (Mercer 1987a).

Biological Profile - Atlantic Croaker

Natural mortality rate: Estimates range from 39-63% a year.

Fecundity: 100,800 to 1,742,000 eggs/fish at sizes ranging from 196-390 mm TL (7.7 -15.4" TL).

Longevity: 7-8 years.

Age/size at maturity: 2-3 years; males at 140-220 mm TL (5.5-8.7"), females at 185-233 mm TL (7.1-9.1" TL).

Spawning and Larval Development

Spawning season: August - December (north of Cape Hatteras); peak spawning occurs in October.

Spawning area: Cape May, New Jersey to Gulf of Mexico, includes the mouth of the Chesapeake Bay.

Location: 25 to 265 feet deep.

Salinity: 30 ppt.

Dissolved oxygen: At least 5.0 ppm.

Young-of-Year

Location: Post-larvae move into estuarine waters in late summer and early fall where they develop into juveniles.

Salinity: 0-30 ppt.
Temperature: Collected at 0-24°C (32-75°F) in the upper Chesapeake Bay.
Dissolved oxygen: At least 5.0 ppm.

Subadults and Adults

Location: Shallow coastal and estuarine waters in summer; deep, offshore waters in fall.
Salinity: Euryhaline, most frequently found in 5-30 ppt.
Temperature: 8-34°C (46-93°F) on the Atlantic Coast.
Dissolved oxygen: At least 5.0 ppm.

Life History - Spot

Spot can be found along the coast and in estuarine waters from the Gulf of Maine to the Bay of Campeche, Mexico. The area of greatest abundance occurs from Chesapeake Bay to South Carolina (Bigelow and Schroeder 1953). They have been collected from the mainstem and all tributaries of the Chesapeake Bay and have one of the most extensive distributions of any marine-estuarine fish species in the Bay. Spot are considered one of the major regulators of benthic invertebrate communities in the muddy, shallow (<10m or 32.5') zones of the Bay (Homer and Mihursky 1991). They are an important food source for other species in the Bay. Predators include striped bass, bluefish, weakfish, shark, and flounder (Mercer 1987b).

Adult spot migrate into estuarine areas in the spring but are not as widely distributed as young spot. They are generally found in the Chesapeake Bay from April through October. Spot are euryhaline and salinity does not appear to affect distribution. They are tolerant of a wide range of temperatures and have been collected in waters from 1.2°C to 36.7°C (34-98°F). Although they can tolerate low temperatures, extended periods of low temperatures can result in mortality. They are relatively short-lived, with age V fish a rarity. Ages 0 to II dominate the catch from populations along the Atlantic coast (as cited by Mercer 1987b). Spot reach sexual maturity at age II and III. Minimum size at maturity ranges from 186 to 214 mm TL (7.3-8.4") (Mercer 1987b). Fecundity estimates are available from a small sample (n=2, Dawson 1958) and it is not known if they are representative of fully ripe fish.

When the water temperature starts to decrease in the fall, adult spot move offshore to spawn. The spawning season extends from late fall to early spring. Spawning occurs over a broad area and data indicate that they use areas further offshore and in deeper waters than other sciaenids (Mercer 1987b). Larvae move into estuarine areas as early as December. In the Chesapeake Bay, spot larvae have been collected during January and February (Welsh and Breder 1923). Low salinity areas of bays and tidal creeks comprise the primary nursery habitat for spot. They are also associated with eelgrass communities (Orth and Heck 1980).

Young-of-the-year spot generally reside in tidal creeks and shallow, estuarine areas during the summer. When the water temperature begins to decrease in the fall they move to deeper estuarine waters or the ocean. There is some evidence that juvenile spot overwinter in Chesapeake Bay in deep water (Mercer 1987b). Juvenile spot are similar to adults in their ability to tolerate a wide range of salinities and temperatures.

Like croaker, spot are opportunistic bottom feeders that eat polychaetes, crustaceans, mollusks, and detritus (as cited by Mercer 1987). Although both spot and croaker have similar diet and habitat, a life history study in the York River Estuary, Virginia concluded that they are able to coexist without directly competing with one another because of spatial and temporal differences (Chao and Musick 1977).

Biological Profile - Spot

<u>Natural mortality rate:</u>	Currently unknown.
<u>Fecundity:</u>	Only limited data available (n=2). Mature females produce at least 70,000 - 90,000 eggs.
<u>Longevity:</u>	4-5 years.
<u>Age/size at maturity:</u>	On the Atlantic Coast, spot mature at the end of their second year or early in their third year at 186-214 mm TL (7.3-8.4").

Spawning and Larval Development

Spawning season:	Spawning off Chesapeake Bay occurs from late fall to early spring.
Spawning area:	Offshore coastal areas.
Spawning location:	Spawning occurs more heavily offshore (78-384') than inshore (44- 60').

Salinity: At least 20 ppt.

Dissolved oxygen: > 2.0 ppm.

Young-of-the-year

Location: Low salinity Bay waters and tidal marsh creeks with mud and detrital bottoms; young-of-the-year are also associated with eelgrass beds in Chesapeake Bay.

Salinity: 0 - 30 ppt.

Temperature: 1.2- 35°C (34-95°F).

Dissolved oxygen: > 2.0 ppm.

Subadults and Adults

Location: Mud and sandy bottoms in inshore waters; offshore to at least 40'.

Salinity: 0 - 30 ppt.

Temperature: 1.2- 35°C (34-95°F). Mortalities due to prolonged cold spells have been observed in the Maryland portion of the Chesapeake Bay.

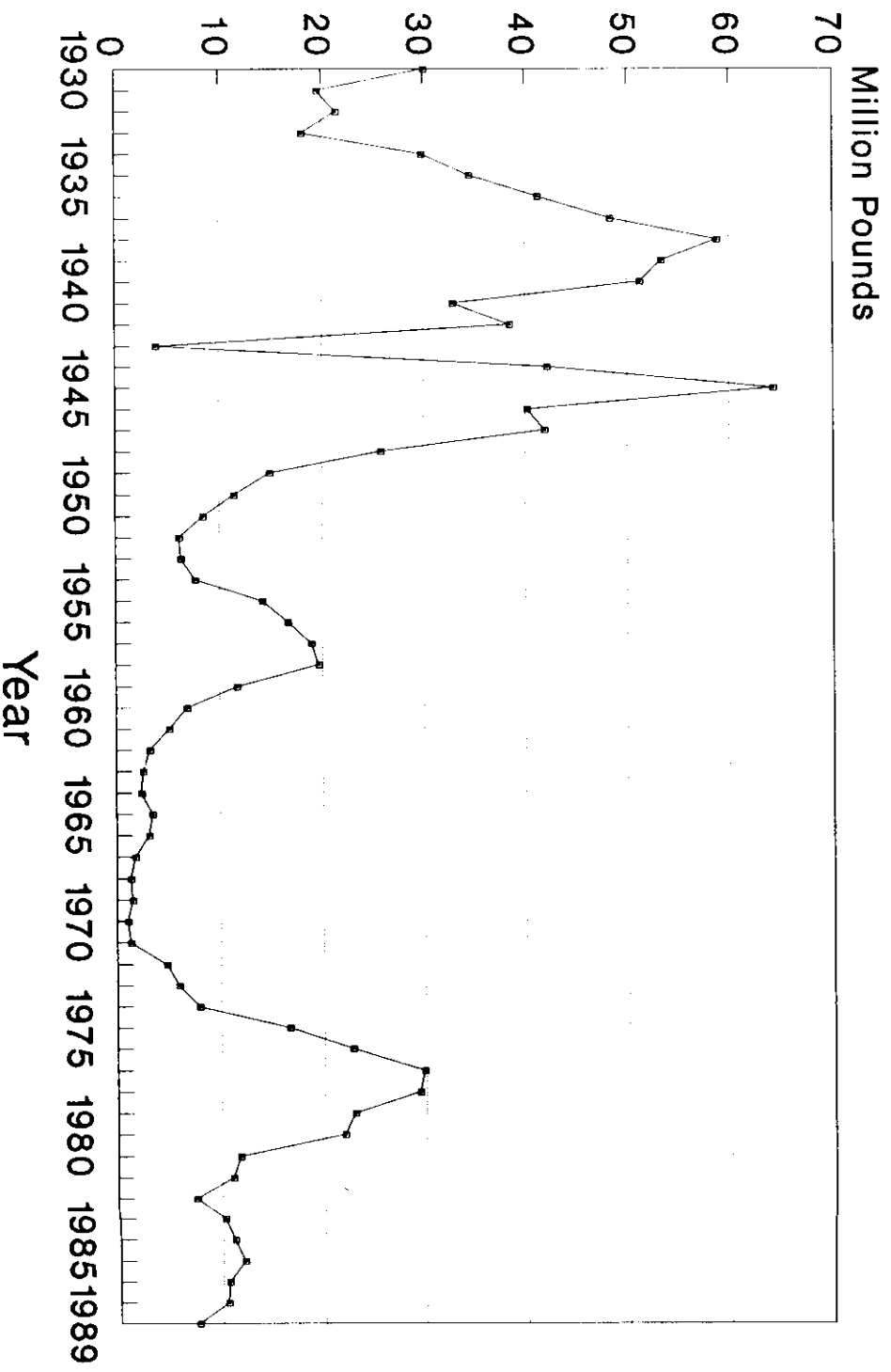
Dissolved oxygen: > 2.0 ppm.

The Fishery - Atlantic Croaker

Commercial landings of Atlantic croaker from the Atlantic coast show a period of record high landings during the 1940's of 65 million pounds (Figure 1). By the early 1950's, the commercial catch had decreased to less than 10 million pounds but was followed by a moderate increase. A record low commercial catch of 1 million pounds was recorded in 1970. There was a moderate peak in 1978 of 30 million pounds but over the last 10 years, croaker landings have declined to approximately 10 million pounds. The 1990 landings were 6.7 million pounds with the majority of the catch from the South Atlantic, particularly North Carolina.

Commercial landings for croaker from the Chesapeake Bay declined dramatically from almost 60 million pounds in the 1940's to approximately 2 million pounds in the 1980's (Figure 2a). Historically, the Chesapeake region accounted for the majority of Atlantic Coast commercial croaker landings. Maryland landings reached a high of 6 million pounds in 1942 but have ranged from

Figure 1. Croaker Commercial Landings from the Atlantic coast



source: NMFS data

Figure 2a. Commercial Landings for Atlantic Croaker from the Chesapeake Bay

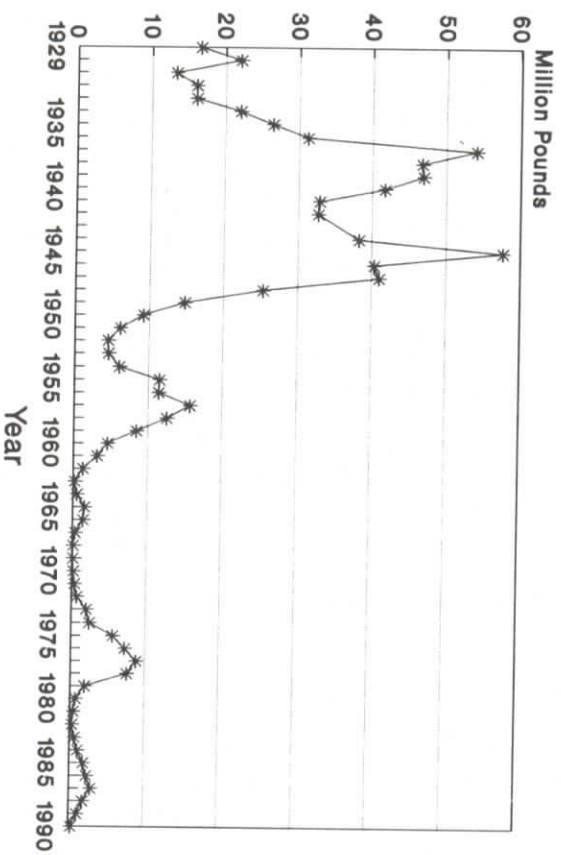


Figure 2b. Maryland Commercial Landings for Atlantic Croaker

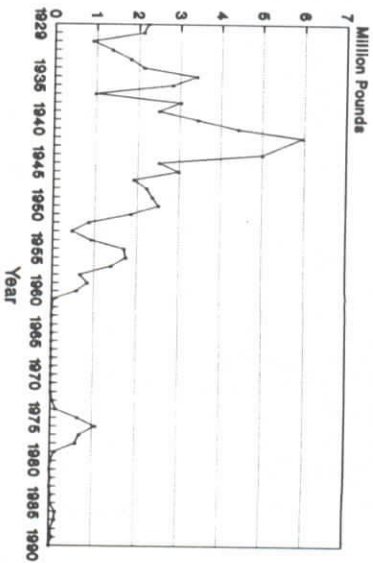
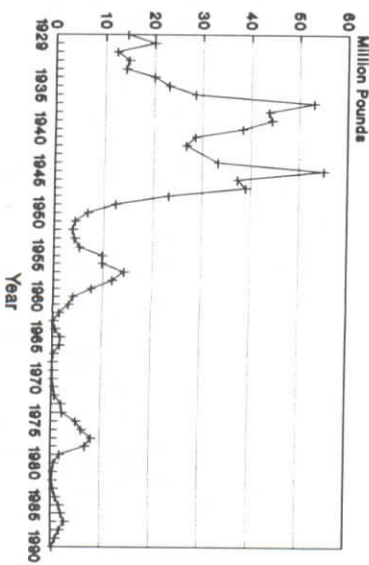


Figure 2c. Virginia Commercial Landings for Atlantic Croaker



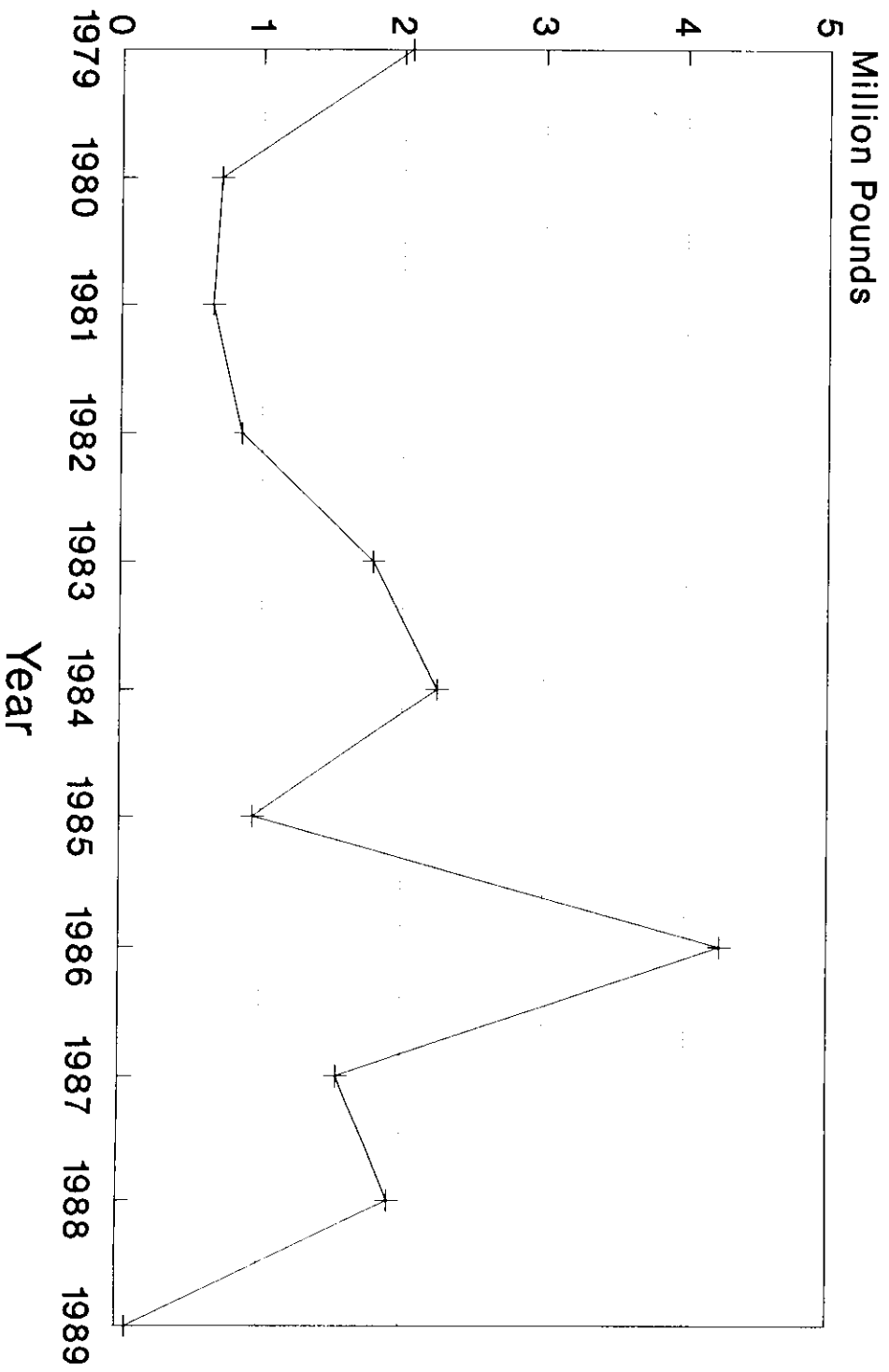
1.06 million pounds (1976) to 500 pounds over the last twenty years (Figure 2b). Virginia landings have been as high as 55 million pounds (1937) but in the last few years have averaged 2.38 million pounds (Figure 2c). In 1990, the Chesapeake region harvested 196,000 pounds. Without effort information from fisheries within the Bay, it is difficult to determine how changes in fishing practices and market demands have influenced commercial landings and, therefore, abundance trends. Despite the lack of effort data from the Bay fisheries, the decline in catch most likely represents a real decrease in abundance. Catch-per-unit-effort (CPUE) data from the North Carolina winter trawl surveys indicate decreasing trends in catch. The North Carolina fisheries have also observed an increase in the proportion of small unmarketable fish (<225 mm or 9") in the last few years.

Since croaker are considered a southern species, landings north of Chesapeake Bay occur only when the population abundance is high or under particularly favorable environmental conditions. It has been suggested that periods of high landings and northward range extension are associated with warming trends and mild winters; cold winters reduce recruitment (Norcross 1983). Croaker are caught by a variety of gear types usually in mixed species fisheries. The average size caught differs by gear type. Generally, fish are smaller in trawl catches (less than or equal to 200 mm TL or 7.9") and larger from pound nets (greater than or equal to 210 mm TL or 8.3") (Chittenden et al. 1990). In the Chesapeake Bay, croaker are caught from spring (early April) through early fall (mid-October) primarily by pound nets.

Croaker are considered an important recreational species in the Chesapeake Bay. They usually rank within the top 10 species caught. Maryland recreational catches in 1979 and 1980 were estimated at 1.07 million pounds and 18,150 pounds, respectively (Williams et al. 1984, Williams et al 1983). Virginia recreational catches in 1985 and 1986 were 5.5 and 3.06 million pounds, respectively. Recreational landings from the mid-Atlantic region estimated by the Marine Recreational Fisheries Statistical Survey (MRFSS) peaked in 1986 but have been declining (Figure 3). In 1990, the downward trend in recreational catch continued.

In addition to the commercial and recreational catch of market size croaker, small croaker are regularly caught in several commercial fisheries. As an example, croaker with a mean weight of 0.144 kg (0.32 lbs or 5 oz.) comprised 41.5% by weight and 34% by number of the total marketable fish in the North Carolina long haul seine catches during the 1989 season. Croaker of similar size and weight are caught by flynets. Scrap fish (part of the catch not marketed for human consumption but sold for bait, industrial use, or discarded), comprised between 2% and 53% (average-28%) of the North Carolina flynet catch between October 1985 and April 1988. Scrap catch also occurs in the pound net and trawl fisheries. There

**Figure 3. Atlantic Croaker caught
by Recreational Anglers, Mid-Atlantic**



*1988 and 1989 numbers are preliminary

is a sizeable bycatch and discard mortality of small croaker from the southern shrimp fishery. Scrap catch, bycatch, and discard mortality significantly impact the croaker population (Mercer 1987a). The magnitude of these impacts on the Chesapeake Bay population has not been fully investigated.

Fishery Parameters - Atlantic Croaker

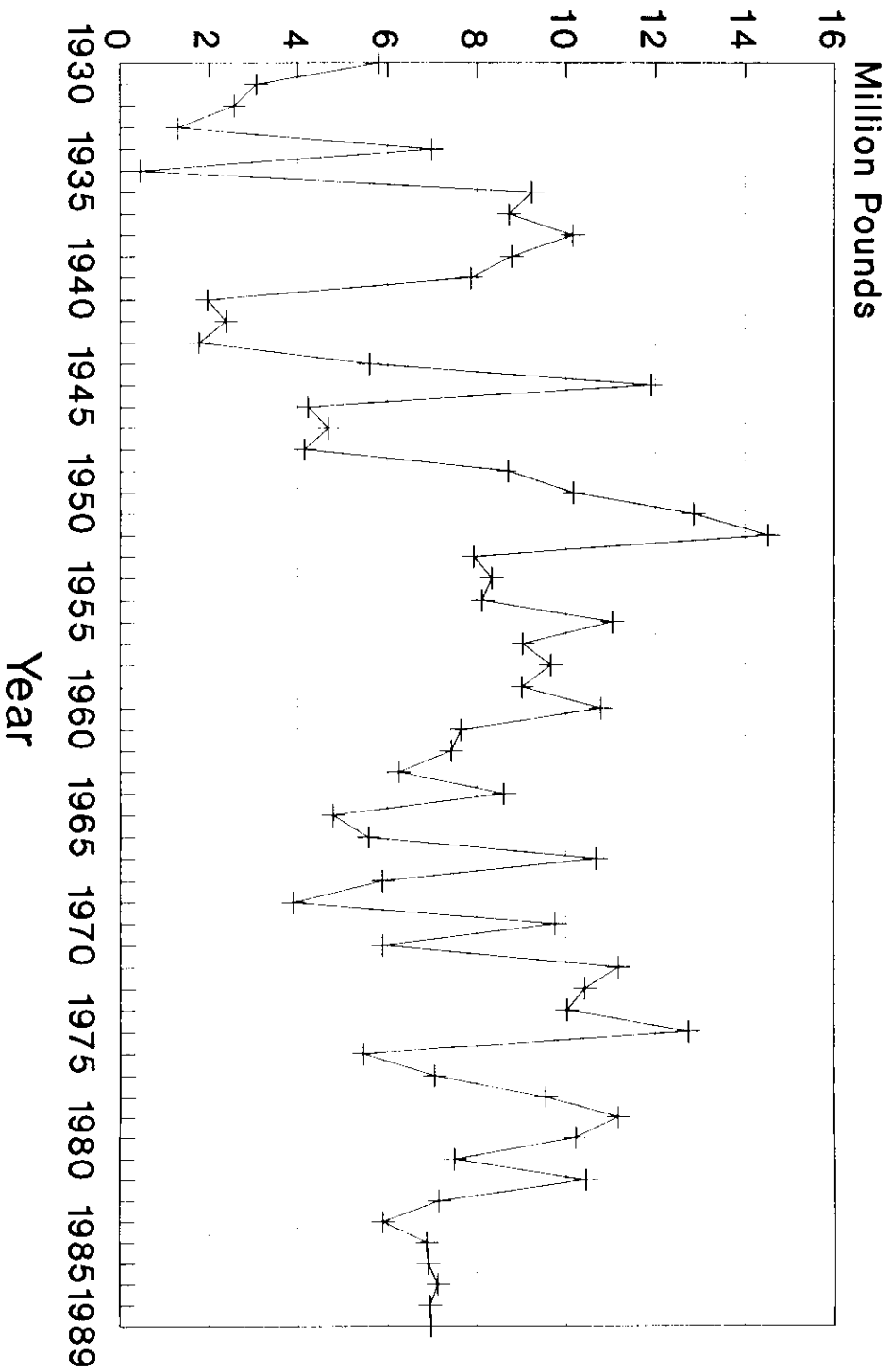
Status of exploitation:	Unknown, but likely near capacity.
Long term potential catch:	Currently unknown.
Importance of recreational fishery:	Significant in Virginia, currently of variable importance in Maryland.
Importance of commercial fishery:	Historically significant.
Total annual mortality:	Estimated at 68% a year based on an analysis of the northern stock.

The Fishery - Spot

Commercial landings for spot from both the Atlantic coast and the Chesapeake Bay exhibit year-to-year fluctuations with no apparent long-term trends (Figures 4 and 5a). Yearly fluctuations in harvest can be attributed to the general life history of spot and annual environmental differences on the spawning grounds (Joseph 1972). Spot is a short-lived species and in most years the commercial catch consists of a single year class. Other factors such as fishing effort, habitat degradation, and economic conditions also contribute to the annual fluctuations in commercial landings (Mercer 1987b). Before 1960, the Chesapeake and South Atlantic regions harvested almost equal amounts of spot. South Atlantic landings currently account for the largest portion of the total Atlantic coast harvest. For 1990, a total of 6.4 million pounds were landed from the Atlantic coast with 4.6 million pounds coming from the South Atlantic, 1.7 million from the Chesapeake, and the remainder from other mid-Atlantic areas.

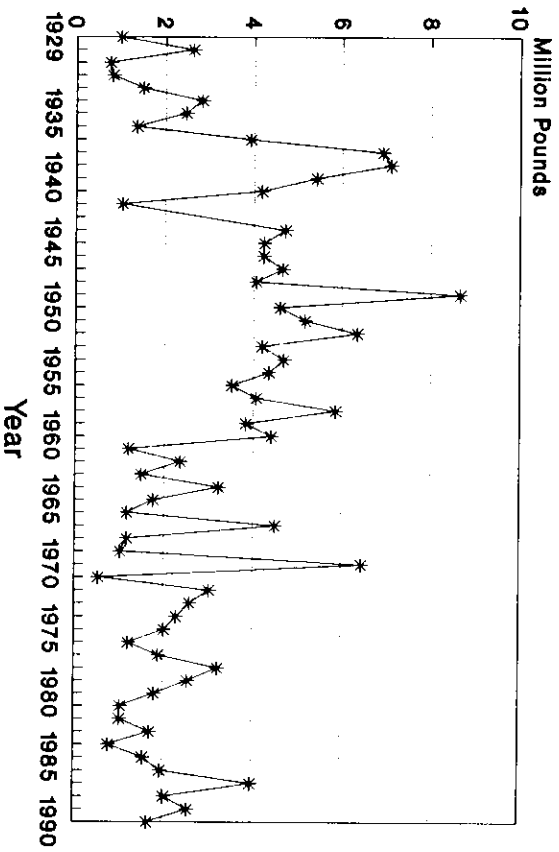
Within the Chesapeake Bay, the commercial harvest of spot usually begins during April or May and continues until September or October. The largest commercial catches are reported during fall when spot are migrating out of the Bay and most spot are landed as bycatch from the pound net fishery in the lower Bay (Homer and Mihursky 1991). In Maryland, commercial catches have been as large as 590,000 pounds (late 1950s) but in recent years have been less than 100,000 pounds (Figure 5b). Landings in Virginia have historically been an order of magnitude higher than those in Maryland. Spot catches in Virginia have been as high as 8 million pounds (1949) and have generally declined since then (Figure 5c).

Figure 4. Spot Commercial Landings from the Atlantic coast

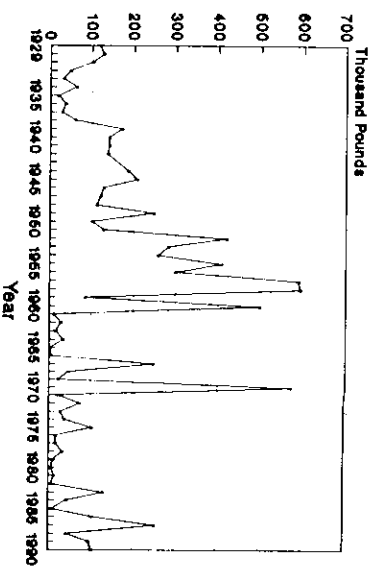


source: NMFS data

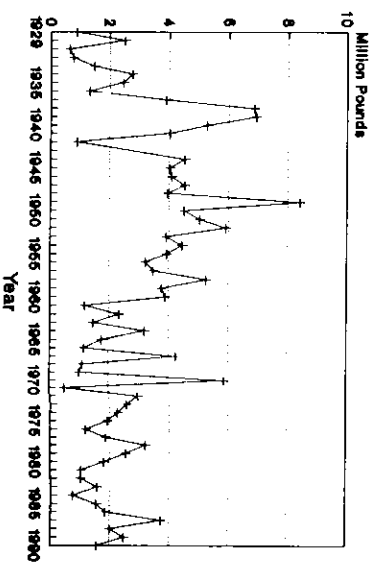
**Figure 5a. Commercial Landings for Spot
from the Chesapeake Bay**



**Figure 5b. Maryland Commercial Landings
for Spot**



**Figure 5c. Virginia Commercial Landings
for Spot**



The recreational catch from the Atlantic coast has fluctuated between 12.5 million fish and 31.4 million fish (5.0 to 13.3 million pounds) since 1979. For 1990, the recreational catch of spot was 18.9 million fish (15.6 million came from the mid-Atlantic). Of the 18.9 million caught, 11.3 million fish were harvested. The recreational catch of spot from the Chesapeake region (in pounds) has exceeded the commercial catch from the same area except for 1989 (Figure 6 and 7). In Maryland, spot are one of the species most frequently caught by recreational fishermen. Spot ranked third in a 1980 recreational fishing survey with an estimated catch of more than 1.3 million fish. In Virginia, spot are generally larger, more abundant, and targeted by recreational anglers. Spot ranked first in pounds landed in 1985 (3 million pounds) and fifth in 1986 (1.6 million pounds). In numbers harvested, spot ranked first in 1985 (11 million) and second in 1986 (8.3 million).

Similar to croaker, small spot are caught for scrap in the pound net, trawl, and long haul seine fisheries. There is a sizeable bycatch and discard mortality of small spot from the southern shrimp fishery, long haul seine and the flynet (a high profile or high-rise type of trawl) catch. As an example, about 95% of spot caught in the North Carolina flynet fishery between 1982 and 1988 were less than marketable size (< 195mm or 7.7"). Scrap catch, bycatch, and discard mortality significantly impact the spot population (Mercer 1987b).

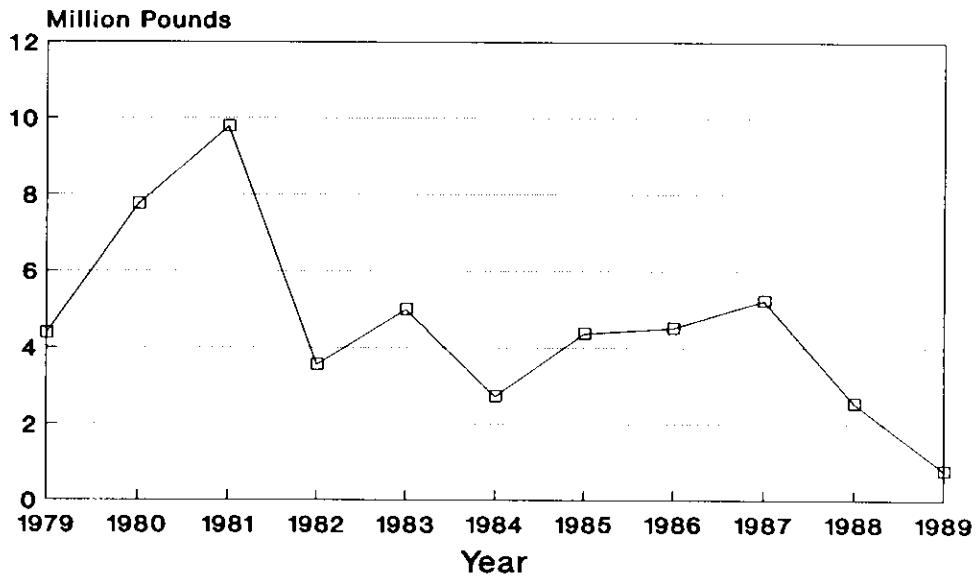
Fishery Parameters - Spot

Status of exploitation:	Currently unknown.
Long term potential catch:	Currently unknown.
Importance of recreational fishery:	Highly significant in Maryland and Virginia
Importance of commercial fishery:	Highly significant in Virginia with landings at least an order of magnitude greater than Maryland.
Fishing mortality rates:	Currently unknown.

Economic Perspective - Atlantic Croaker and Spot

Croaker and spot are two of the five sciaenid fishes that account for about 18 percent of the landed value of all food fish from the mid-Atlantic through the Gulf coast. In Maryland, trends in dockside value for croaker and spot have generally followed commercial landings (Figure 8 and 9). Despite the variability in commercial landings, the dockside values for croaker and spot in Virginia have remained steady (Figure 10 and 11). Since 1980, the price per pound of croaker and spot in Virginia has increased.

Figure 6. Spot caught by Recreational Anglers, Mid-Atlantic Region



-1988 and 1989 numbers are preliminary

Figure 7. Spot caught by the Commercial fishery, Mid-Atlantic Region

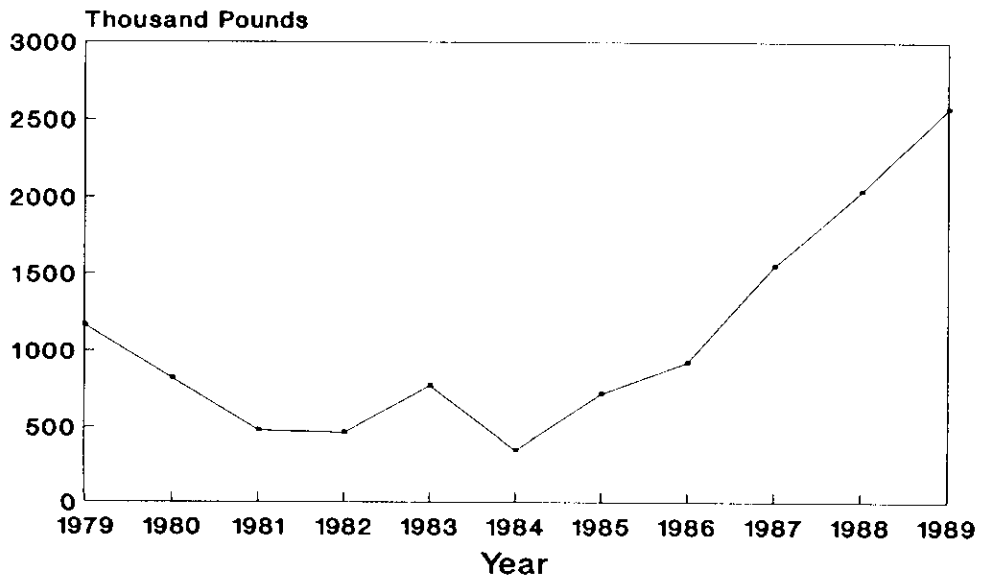
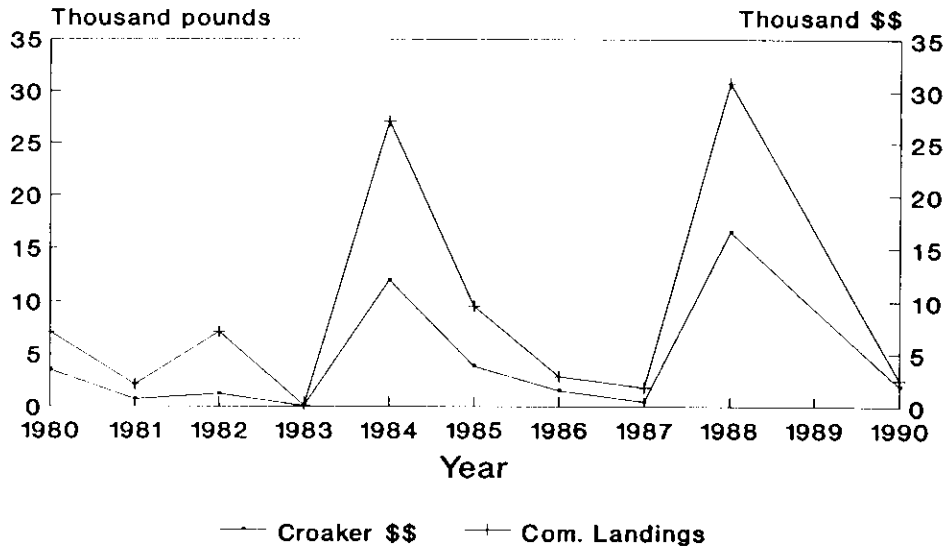
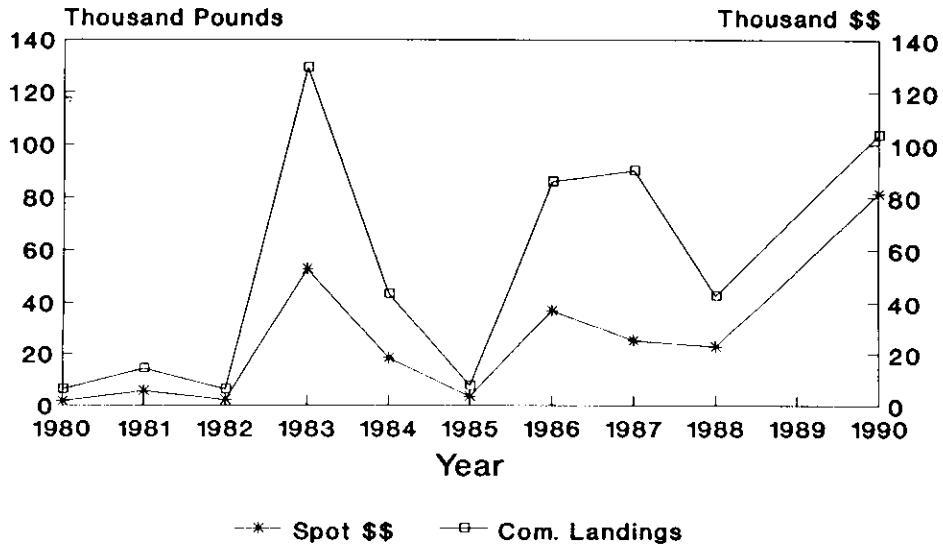


Figure 8. Maryland Dockside Value for Croaker



•1990 preliminary

Figure 9. Maryland Dockside Value for Spot



•1990 preliminary

Figure 10. Virginia Dockside Value for Atlantic Croaker

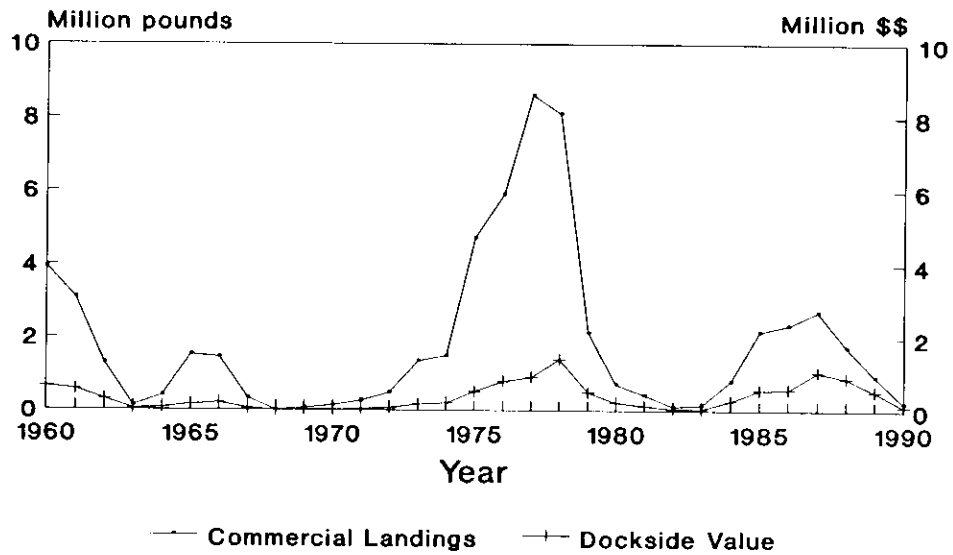
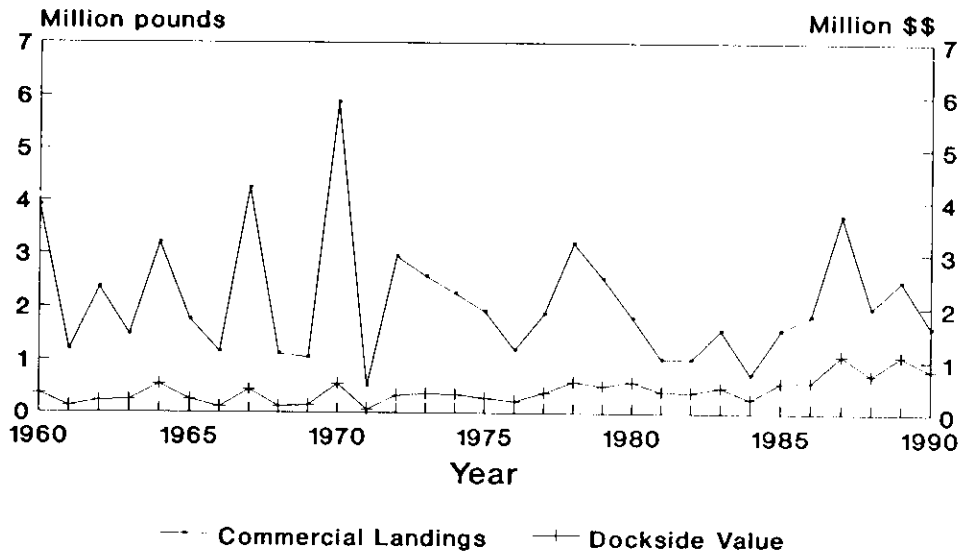


Figure 11. Virginia Dockside Value for Spot



A socio-economic profile on croaker was completed in 1978 by Austin et al. At this time the following conclusions were made: 1) small croaker were a low value/high volume product and an expanded market could place severe pressure on the stocks unless the incidental catch of croaker were reduced; 2) food croaker (large croaker) are of minor importance to fish houses and there is a substantial incidental catch of small croaker that is discarded; 3) there is a very large incidental catch of croaker associated with the commercial shrimp fishery, estimated at twice the size of the total commercial catch of croaker, and 4) recreational fishing will continue to expand. Since current information is lacking, these areas of socio-economic importance need to be reevaluated.

The value of spot from the northeast region (ME to VA) has been approximately 1 million dollars over the last few years. The 1989 value was \$1,113,000 and the preliminary 1990 value was \$878,000. Although the recreational catch of spot is significant, its economic value along the coast and from the Chesapeake Bay has not been estimated.

Habitat Issues - Atlantic Croaker and Spot

Both croaker and spot utilize estuarine and coastal oceanic waters at various life history stages and times of the year. Habitat alterations within estuarine areas affect croaker and spot stocks because they use these areas as nursery grounds. Most estuarine areas of the United States have been altered to some degree by such activities as agriculture drainage, flood control, development, filling of shallow water habitat, dredging of navigation channels, and pollution. Federal and state programs have been initiated to protect both coastal and estuarine waters.

In addition to problems caused by habitat alteration, spot are particularly sensitive to both chlorinated sewage effluent and to residual chlorine in seawater. In the 1970's, massive fish kills estimated at 5 - 10 million individuals (spot, bluefish, white perch, weakfish and menhaden) were observed in the James River, Virginia adjacent to two sewage treatment plants. Low dissolved oxygen can affect croaker and spot distribution by limiting their prey distribution. It can also limit their distribution by direct avoidance of areas with stressful dissolved oxygen concentrations.

FMP Status and Management Units

Atlantic croaker and spot management plans were prepared under the Atlantic States Marine Fisheries Commission's (ASMFC) Interstate Fisheries Management Program and completed in October 1987. Management measures for both species were reevaluated in 1990 by the ASMFC scientific and statistical committee. The committee emphasized the need to: promote the development and use of bycatch reduction devices (BRDs) through demonstration and application in trawl fisheries; promote increases in yield per recruit by delaying

entry to both the croaker and spot fisheries to ages greater than one; and, implementation of research and monitoring projects. The ASMFC plan recommends a coastwide stock assessment for croaker within the next two years. The ASMFC's plans serve as the basis for the Chesapeake Bay Atlantic croaker and spot FMPs.

The management units are the Atlantic croaker, Micropogonias undulatus, and spot, Leiostomus xanthurus, throughout their range along the Atlantic coast and in the Chesapeake Bay and its tributaries.

Resource Status- Atlantic Croaker

Commercial landings of Atlantic croaker from the Chesapeake Bay suggest that there has been a reduction in abundance. The most recent increase in landings along the Atlantic coast can be attributed to increases in North Carolina landings. An assessment of North Carolina's winter trawl fishery indicates that the current fishery is harvesting much smaller croaker than in previous years (NCDNR 1990). Catch-per-unit-of-effort (CPUE) data from the North Carolina flynet catches also indicate a decline in catch from 1985-86 to 1987-88.

Based on CPUE indices for juvenile Atlantic croaker from along the coast, annual recruitment is highly variable. Maryland and Virginia surveys indicate high juvenile abundance in the mid-1970's with another peak in the early 1980's. The most likely explanation for the fluctuation in abundance is temperature. Survey results support the premise that year class strength is related to temperatures on the nursery grounds (Joseph 1972). There is also strong evidence to suggest that species interaction, such as predation on young croaker by striped bass, has had a negative influence on croaker population levels (Dovel 1968).

Resource Status- Spot

There are no obvious trends in abundance of spot in the Chesapeake Bay region or from the Atlantic coast based on commercial landings data. Abundance estimates are not available based on stock assessment analysis. Annual variations can be attributed to variations in year class strength, environmental conditions, and fishing pressure.

Laws and Regulations

Limited entry: Maryland's Delay of Application Process, which went into effect September 1, 1989, requires previously unlicensed applicants to wait two years after registering with MDNR before a license to harvest finfish with commercial fishing gears will be issued.

Virginia - Proposed legislation authorizing the VMRC to limit or delay entry to fisheries (House Bill 286) was introduced to the 1990 Virginia General Assembly. The Bill was tabled and assigned to a legislative subcommittee for further study.

Potomac River - Current moratorium on any new commercial hook and line or gill net licenses, only Maryland and Virginia residents allowed to fish commercially.

Minimum size limit:

Atlantic Croaker-

Maryland- 10" TL; Potomac River-10" TL; Virginia- None.

Spot-

No minimum size for any of the jurisdictions.

Creel limit:

None in effect for either species for any of the jurisdictions.

Harvest quotas:

None in effect for either species for any of the jurisdictions.

By-catch restrictions:

None in effect.

Season:

No closed season.

Gear - Area restrictions:

Maryland - purse seines, trawls, trammel nets, and monofilament gill net prohibited. (Otter and beam trawls are legal on the Atlantic Coast at distances of one mile or more offshore). Prohibition on gill netting in most areas of Chesapeake Bay and its tributaries, except: (1) attended drift gill nets 2.5 to 3.5" stretch mesh may be fished outside the striped bass spawning reaches and; (2) anchor, stake and drift gill net 4.0 to 6.0" stretch mesh can be fished in Chesapeake Bay, excluding the tributaries south of Kent Point from June 15 to September 30, inclusive. Minimum stretch mesh size restrictions for pound net - 1.5", haul seine - 2.5".

Potomac River - Current moratorium on any new gill net or hook and line licenses.

The use of a spear, gig, purse net, beam trawl, otter trawl, or trammel net are prohibited. Mesh size restrictions on pound net- 1.5", haul seine- 1.5", fyke net- 1.5", fish pot- 2.0", gill net 5.0" with a maximum of 7.0". Length limitations on pound net (1200'), stake gill net (600'), anchor gill net (600' X 12'), fyke net (400'), haul seine (1200' or 2400'), fish pot (10'). Seasonal restrictions: Pound net- February 15 through December 15; Anchor or stake gill net- June 1 through November 30; Drift gill net-closed; Haul seine-January 1 through December 31 except Saturdays June 1 through August 31 and Fridays and Saturdays September 1 through May 31.

Virginia - Trawling prohibited in Virginia waters. It is unlawful to set, place or fish a fixed fishing device within 300 yards of the Chesapeake Bay Bridge Tunnel. From April 1 through May 31 the spawning areas of the James, Pamunkey, Mattaponi, and Rappahannock Rivers are closed to stake and anchor gill nets.

Minimum stretch mesh size restrictions: pound net 2"; gill net 2-7/8" (increased to 3" in 1992); haul seine 3" (nets over 200 yards long). No haul seine can be longer than 1000 yards or deeper than 40 meshes. Any gill net not assigned a fixed location, shall be set in a straight line, have no greater depth than 330", shall not exceed 1200' in length, and shall be fished no closer than 200 feet to any other such gill net. Gill nets are prohibited in the Lower Hampton Roads area from the Friday preceding Memorial Day to Labor Day, both days inclusive, from 7:00 A.M. to 5:00 P.M.; gill nets are prohibited in four Eastern Shore Bayside creek mouths (the Gulf, Hungars Creek, Nassawadox Creek and Occohannock Creek) from June 1 to October 31. Also, Sections 28.1-52 and 28.1-53 of the Code of Virginia outline placement, total length and distance requirements for fishing structures.

Status of Traditional Fishery Management Approaches

The following definitions have been adapted from the document, "Status of the Fishery Resources Off the Northeastern United States for 1989" (NOAA Technical Memorandum NMFS-F/NEC-72). For a more thorough review of fisheries terminology, refer to this document under the section "Definition of Technical Terms."

Catch-Effort or Catch-Per-Unit-of-Effort: Defined as the number or weight of fish caught during a specific unit of fishing time and considered a basic measure of abundance or stock density.

Atlantic Croaker- Catch and effort data from both the commercial and recreational fisheries in the Chesapeake Bay are insufficient to determine the relationship between landings and abundance. Although trends in landings do not necessarily reflect actual abundance, there are indications that croaker abundance has declined. The CPUE from the North Carolina flynet catch declined from 5,868 kg/catch in 1985-86 to 1,629 kg in 1987-88.

Spot- Catch and effort data from both the commercial and recreational fisheries in the Chesapeake Bay are insufficient to determine the relationship between landings and abundance. Spot CPUE from the North Carolina sciaenid-bluefish flynet catches have fluctuated with no apparent trend. Mean seasonal CPUEs ranged from 369 to 1,391 kg/trip, with three-season averages of 788 kg/trip (1982-85) and 817 kg/trip (1985-87).

Estimates of mortality: Instantaneous mortality is defined as the rate at which fish are removed from a population by death (Z). It can be represented mathematically by the natural logarithm of a ratio of the number of fish alive at the end of a unit of time, to the number alive at the beginning of the unit of time. It can also be expressed as a percentage of the population.

Atlantic Croaker- Total mortality rates are 37-60% when maximum age is set between five and ten years, and mortality rates are 55-60% ($Z=1.15$) for five or six year life spans (Chittenden et al. 1990). A $Z=1.15$ is appropriate for Chesapeake Bay fish which translates to a 55-60% annual total mortality.

Spot- Mortality rates are unknown.

Yield-per-Recruit: A mathematical calculation of the theoretical yield that would be obtained from a year class (group of fish of one age) if they were harvested according to a certain exploitation pattern over their life span.

Atlantic Croaker- If instantaneous natural mortality (M) values are between 0.5 and 1.0, then calculated yield per recruit is between 32 and 91 g at an age at first capture of 1.5 years; and, between 25 and 125 g at an age at first capture of 3 years (Chittenden 1977).

Spot- Since current mortality rates are unknown, yield per recruit analysis has not been calculated.

Spawning Stock Biomass (SSB)- The total weight of all sexually mature fish in the population. This changes depending on the size of new year classes, the growth rate of young fish, the age at sexual maturity, the growth and natural mortality of older fish, and the fishing mortality rate:

Atlantic Croaker- Unknown.

Spot- Unknown.

Spawning Stock Biomass Per Recruit (SSBR)- The spawning stock biomass divided by the number of fish recruited to the stock at age 2. This number is in units of weight and measures the average or expected contribution of any one young fish to the spawning stock biomass over its lifetime:

Atlantic Croaker- Unknown.

Spot- Unknown.

Stock-Recruitment: The relationship between the adult stock size and subsequent recruitment (fish that reach a certain size or age in a specific year):

Atlantic Croaker- Successful recruitment into the Chesapeake Bay and survival during the juvenile stage is mainly determined by environmental factors. Warm winter water temperatures allow spawning to occur further north and contribute to a higher survival rate of overwintering juveniles. During times of adverse environmental conditions, the fishery becomes heavily dependent on North Carolina breeding stocks.

Spot- A first approximation of a Ricker spawner-recruit relationship has been examined by D. Bodolus, VIMS. No significant relationship between the two could be discerned. However, from this study the spawning population appears to account for approximately 10% of the variation in recruitment of spot to the Chesapeake Bay.

Maximum Sustainable Yield: The number or weight of fish in a stock that can be taken by fishing without reducing the stock's biomass or reproductive potential from year to year, assuming that environmental conditions remain the same.

Atlantic Croaker- Unknown.

Spot- Unknown.

Virtual Population Analysis: Defined as an analysis of fish catches from a given year class over its life in the fishery.

Atlantic Croaker- Has not been carried out.

Spot- Has not been carried out.

Data and Analytical Needs- Atlantic Croaker

1. Collect information on the biology and population dynamics including data on growth, age structure, reproductive biology, migration patterns, mortality, long-term potential yield, and stock structure.
2. Determine the relationship between parental stock size and environmental factors on year class strength.
3. Improve catch and effort data for both the commercial and recreational croaker fisheries.
4. Determine the magnitude of incidental by-catch and discard mortality of small croaker in non-directed fisheries in the Chesapeake Bay.
5. Determine the magnitude of the scrap/bait catch of croaker from the pound net, long haul seine, and trawl fisheries.

Data and Analytical Needs- Spot

1. Determine the coastal movement of spot and the extent of stock mixing.
2. Collect biological data including size and age composition of harvest, age at maturity, fecundity, and spawning periodicity.
3. Improve catch and effort data.
4. Determine a measure of annual reproductive success and information on the relationship between parental stock size and environmental factors that regulate year class strength.

References Cited

- Austin, C.B., J.C. Davis, R.D. Brugger, and J.A. Browder. 1978. Croaker Workshop Report and Socio-Economic Profile. NMFS Southeast Fisheries Center. Sea Grant Special Report No. 16.
- Bigelow, H.B., and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish. Wild. Serv., Fish. Bull. 53:423.
- Chao, L.N., and J.A. Musick. 1977. Life history, feeding habits, and functional morphology of juvenile sciaenid fishes in the York River estuary, Virginia. Fish. Bull. 75:657-702.
- Chittenden, M.E., Jr., L.R. Barbieri, C.M. Jones, S.J. Bobko, and D.E. Kline. 1990. Initial information on the Atlantic croaker, a final report on "Development of age determination methods, life history-population dynamics information, and evaluation of growth overfishing potential for important recreational fishes." Virginia Institute of Marine Science, Gloucester Point, Virginia.
- Chittenden, M.E., Jr., and J.D. McEachran. 1976. Composition, ecology, and dynamics of demersal fish communities on the northwestern Gulf of Mexico continental shelf, with a similar synopsis for the entire Gulf. Tex. A & M Univ., TAMU-SG-76-208. 104p.
- Cowan, J.H., Jr., and R.S. Birdsong. 1985. Seasonal occurrence of larval and juvenile fishes in a Virginia Atlantic coast estuary with emphasis on drums (Family Sciaenidae). Estuaries 8(1):48-59.
- Dovel, W.L. 1968. Predation by striped bass as a possible influence on population size of the Atlantic croaker. Trans. Amer. Fish. Soc. 97:313-319.
- Haven, D.S. 1957. Distribution, growth and availability of juvenile croaker, Micropogon undulatus, in Virginia. Ecology 38:88-97.
- Hildebrand, S.F., and W.C. Schroeder. 1928. The fishes of Chesapeake Bay. Bull. U.S. Bur. Fish. 43(1):388p.
- Homer, M.L., and J.A. Mihursky. 1991. Habitat requirements for Chesapeake Bay living resources: Spot profile. Chesapeake Bay Research and Monitoring, 2nd Edition.
- Joseph, E.B. 1972. The status of the sciaenid stocks of the middle Atlantic coast. Ches. Sci. 13:87-99.

- Mercer, L.P. 1987a. Fishery management plan for Atlantic croaker (Micropogonias undulatus). Fish. Rept. No. 10 of the Atlantic States Marine Fisheries Commission. 90p.
- Mercer, L.P. 1987b. Fishery management plan for spot (Leiostomus xanthurus). Fish. Rept. No. 11 of the Atlantic States Marine Fisheries Commission. 81p.
- Morse, W.W. 1980. Maturity, spawning and fecundity of Atlantic croaker, Micropogonias undulatus occurring north of Cape Hatteras, North Carolina. U.S. Nat. Mar. Fish. Serv. Fish. Bull. (U.S.) 78(1):190-195.
- Norcross, B.L. 1983. Climate scale environmental factors affecting year-class fluctuations of Atlantic croaker (Micropogonias undulatus) in the Chesapeake Bay. Ph.D. diss., Coll. William & Mary, Williamsburg, 387 p. +append.
- North Carolina Department of Environment, Health, and Natural Resources. 1990. Assessment of the North Carolina winter trawl fishery, Sept. 1982- Apr. 1985. Special Scientific Report No. 53. Division of Marine Fisheries, Morehead City, N.C. 94p.
- Orth, R.J., and K.A. Heck, Jr. 1980. Structural components of eelgrass (Zostera marina) meadows in the lower Chesapeake Bay fishes. *Estuaries* 3:278-288.
- Stagg, C. 1986. An evaluation of the information available for managing Chesapeake Bay fisheries: Preliminary stock assessments. Vol. II, Atlantic Croaker. University of Maryland, UMCEES[CBL] 85-29, 148p.
- Wallace, D.H. 1940. Sexual development of the croaker, Micropogon undulatus, and distribution of the early stages in Chesapeake Bay. *Trans. Am. Fish. Soc.* 70:475-482.
- Welsh, W.W., and C.M. Breder. 1923. Contributions to life histories of Sciaenidae of eastern United States coast. *Bull. U.S. Bur. Fish.* 39:141-201.
- White, M.L., and M.E. Chittenden, Jr. 1977. Age determination, reproduction and population dynamics of the Atlantic croaker, Micropogonias undulatus. U.S. Nat. Mar. Fish. Serv. Fish. Bull. 75:109-123.
- Williams, J.B., T.P. Smith, H.J. Speir, and S. Early. 1983. 1980 Maryland Saltwater Sportfishing Survey. Md. DNR Tidewater Admin. TA-CRD-83-1.
- Williams, J.B., H.J. Speir, S. Early, and T.P. Smith. 1982. 1979 Maryland Saltwater Sportfishing Survey. Md. DNR Tidewater Admin. TA-CRD-82-1.

Section 2. Atlantic Croaker and Spot Management

The source documents for this plan, Atlantic States Marine Fisheries Commission Fishery Management Plans for Atlantic Croaker and Spot (Mercer 1987a and 1987b), White and Chittenden (1976), and Joseph (1972) contain current knowledge about stock status and research needs for Atlantic croaker and spot in the Chesapeake Bay and along the Atlantic coast. The following problems and management strategies have been defined and serve as the basis for identifying the goal and objectives. The management strategies and actions will be implemented by the jurisdictions to protect Atlantic croaker and spot stocks in the Chesapeake Bay. Existing regulations regarding the harvest of these species will continue to be enforced except where otherwise indicated by the plan.

A. GOAL AND OBJECTIVES

The goal of this plan is to:

Protect the Atlantic croaker and spot resource in the Chesapeake Bay, its tributaries, and coastal waters, while providing the greatest long term ecological, economic, and social benefits from their usage over time.

In order to achieve the goal, the following objectives must be met:

- 1) Follow the guidelines established by the Atlantic States Marine Fisheries Commission (ASMFC) for coastwide management of the Atlantic croaker and spot stocks and make Bay management actions compatible where possible.
- 2) Maintain Atlantic croaker and spot spawning stocks at a size which minimizes the possibility of recruitment failure and determine the effects of environmental factors on year class strength.
- 3) Promote harvesting practices which minimize waste and maximize the biological and economic return from the resources especially in non-directed fisheries.
- 4) Promote studies to improve the understanding of economic, social, and biological aspects of the commercial and recreational fisheries.
- 5) Continue to provide guidance for the development of water quality goals and habitat protection necessary to protect Atlantic croaker and spot populations within the Bay and coastal waters.

B. PROBLEM AREAS AND MANAGEMENT STRATEGIES

Problem 1 - Stock Status: The most recent peak in Atlantic croaker landings occurred in 1977 and 1978 and were only about half of the historical peaks. Although effort data is lacking, the decline in catch most likely represents a real decrease in abundance. Fluctuations in croaker landings and decreasing abundance may be related to changes in population structure, the influence of environmental factors on the spawning grounds, changes in fishing effort, and the degradation of estuarine habitats.

Spot landings have been highly variable from year-to-year. These annual fluctuations have been attributed to spot's short life span and climatic factors on the spawning grounds. Increasing fishing effort and habitat degradation could lead to declines in spot abundance.

Currently, croaker and spot are not reaching their maximum potential in size before being harvested by the fishery. Both are migratory species along the Atlantic coast which necessitates cooperative interstate management to insure that they are adequately protected during all phases of their life history.

Strategy 1 - Stock Status: The jurisdictions will continue to monitor the Atlantic croaker and spot populations in the Bay. Since both species are migratory, interstate coordination will be emphasized. Increases in yield per recruit will be promoted.

Problem 1.1

Annual abundance of Atlantic croaker and spot stocks is highly dependent on environmental conditions during the spawning season. Fishing generally affects one year class and yield per recruit has not been maximized in the fisheries.

Strategy 1.1

The Bay jurisdictions will continue to monitor the Atlantic croaker and spot stocks and cooperate with the Atlantic States Marine Fisheries Commission to manage the stocks through interjurisdictional management measures.

Action 1.1

Maryland, the Potomac River Fisheries Commission, and Virginia will continue to participate in scientific and technical meetings for managing Atlantic croaker and spot along the Atlantic coast and in estuarine waters.

Implementation 1.1

Continue

Strategy 1.2

The jurisdictions will promote increases in yield per recruit for the Atlantic croaker and spot fisheries.

Action 1.2.1

A) Maryland and the Potomac River Fisheries Commission will continue their 10 inch minimum size for Atlantic croaker.

B) Virginia will implement a minimum size limit for Atlantic croaker if suggested by length-frequency analyses currently being conducted by the Virginia Institute of Marine Science (VIMS) and Old Dominion University (ODU).

Implementation 1.2.1

A) Continue B) 1993

Action 1.2.2

The jurisdictions will evaluate the need for implementing a minimum size limit for spot.

Implementation 1.2.2

1992

Problem 2 - Harvest of Small Croaker and Spot: The incidental bycatch and discard mortality of small croaker and spot in non-directed fisheries such as the southern shrimp fishery and the scrap catch from pound net, long haul seine, and trawl fisheries are substantial and have the potential to significantly impact croaker and spot stocks. The magnitude of bycatch in the Chesapeake Bay fisheries and the impact of Atlantic coast bycatch on Chesapeake Bay populations have not been determined.

Strategy 2 - Harvest of Small Croaker and Spot: The jurisdictions will promote the use of trawl efficiency devices (TEDs) and bycatch reduction devices (BRDs) and investigate other means to reduce the catch of small croaker and spot in non-directed and directed fisheries.

Problem 2.1

The magnitude of the scrap catch, incidental bycatch and discard mortality of small croaker and spot has not been determined but may significantly impact croaker and spot stocks.

Strategy 2.1

The jurisdictions will reduce the harvest of small croaker and spot in the directed and non-directed fisheries.

Action 2.1.1

A) Through the ASMFC, the jurisdictions will promote the development and use of trawl efficiency devices (TEDs) in the southern shrimp fishery and promote the use of bycatch reduction devices (BRDs) in the finfish trawl fishery.

B) Virginia will continue its prohibition on trawling in State waters. Virginia will maintain its 2-7/8" minimum mesh size for gill nets.

C) Maryland will continue its 4-6" gill net restriction during June 15 through September 30 and implement a 3" minimum mesh size along the coast.

D) The PRFC will continue its prohibition on gill net fishing during the summer.

Implementation 2.1.1

A) Continue B) Continue C) 1992 D) Continue

Action 2.1.2

The jurisdictions will investigate the magnitude of the bycatch problem and consider implementing bycatch restrictions for the non-directed fisheries in the Bay.

Implementation 2.1.2

1992

Problem 3 - Research and Monitoring Needs: There is a lack of stock assessment data for both the Atlantic croaker and spot stocks in the Chesapeake Bay. Information on recruitment, age, size and sex composition of the stocks and how they vary with time and space is needed. Assessing the migratory patterns and the extent of stock mixing for both croaker and spot are integral factors in determining appropriate coastal management recommendations. Improved catch and effort data are needed from the recreational and commercial fisheries to assess the impact of fishing activities on the croaker and spot stocks. The socioeconomic profile on Atlantic croaker should be updated and a socioeconomic profile on spot should be undertaken.

Strategy 3 - Research and Monitoring Needs: In order to identify necessary management measures, a program of research and data collection will be pursued for Atlantic croaker and spot.

Problem 3.1

There is a lack of stock assessment data and socioeconomic information for both the Atlantic croaker and spot stocks in the Chesapeake Bay and along the Atlantic coast.

Strategy 3.1

The jurisdictions will promote research on the biology and socioeconomic factors that affect the croaker and spot stocks in the Chesapeake Bay. Research topics that need consideration include: the effects of coastal fishing on croaker and spot abundance in the Bay; the determination of migratory patterns through tagging studies; the monitoring of long-term changes in abundance; the size and age structure of croaker and spot populations within the Bay; and monitoring juvenile abundance to establish a reliable index of year-class strength.

Action 3.1

The Virginia Marine Resources Commission's stock assessment program will continue to analyze size and sex data from Atlantic croaker and spot collected from the Virginia commercial fisheries.

Implementation 3.1

Continue

Action 3.2

A) Maryland and the Potomac River Fisheries Commission will encourage research to collect data on croaker and spot biology, especially estimates of population abundance, recruitment, and reproductive biology.

B) Virginia will continue to fund its stock assessment research conducted by VIMS and ODU, specifically designed to provide estimates of population abundance, recruitment, and reproductive biology.

Implementation 3.2

A) Continue B) Continue

Problem 4 - Habitat and Water Quality Issues: Adult spawning and larval distribution along the continental shelf, and juvenile overwintering within the Chesapeake Bay have been identified as key periods of environmental vulnerability. Habitat alterations within the Bay damage croaker and spot stocks since they are used as nursery grounds. Low dissolved oxygen can affect croaker and spot distribution by limiting their prey distribution. It also affects their distribution through behavioral avoidance of areas with stressful dissolved oxygen concentrations.

Strategy 4 - Habitat and Water Quality Issues: The jurisdictions will continue their efforts to improve water quality and define habitat requirements for the living resources in Chesapeake Bay.

Problem 4.1

Habitat alteration and water quality impact the distribution and abundance of finfish species in the Chesapeake Bay.

Strategy 4.1

The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production.

Action 4.1

The jurisdictions will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for:

- A) Developing habitat requirements and water quality goals for various finfish species.
- B) Developing and adopting basinwide nutrient reduction strategies.
- C) Developing and adopting basinwide plans for the reduction and control of toxic substances.
- D) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources.
- E) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system.
- F) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation.
- G) Managing population growth to minimize adverse impacts to the Bay environment.

Implementation 4.1

Continue

ATLANTIC CROAKER AND SPOT MANAGEMENT PLAN IMPLEMENTATION

PROBLEM AREA	ACTION	DATE	RESPONSIBLE AGENCY & METHOD	ADD. STAFF or \$\$	COMMENTS/NOTES
1. Stock Status	1.1 Continue to participate in scientific and technical meetings.	Continue	ASMFC - A		Coastal coordination is imperative for successful management of croaker and spot stocks.
			MDNR - A		
			PRFC - A		
			VMRC - A		
	1.2.1 MD & PRFC will continue 10" minimum size on croaker. VA. will consider a minimum size.	Continue 1992	MDNR - R		Length frequency analysis by VIMS/ODU may suggest a different minimum size.
			PRFC - R		
			MDNR - A, R		
		1992	PRFC - A, R		Will depend on recommendations from ASMFC after stock assessments have been made.
		Continue	VMRC - R		
2. Harvest of small croaker and spot	2.1.1 Promote trawl efficiency devices and fish separators in trawl fishery. VA. continue to prohibit trawling in State waters and continue minimum mesh size restrictions. MD will continue 4-6" gill net restrictions during summer. PRFC will continue prohibition on gill netting during summer.	Continue	MDNR - A		Coastal regulation of the southern shrimp fishery is important for reducing the catch of small sciaenids.
			PRFC - A		
			VMRC - A, R		
		1992	MDNR - A, R		Pound net harvests should be investigated.
			PRFC - A, R		
			VMRC - A, R		
3. Research and monitoring	3.1 VA continue to provide stock assessment data on croaker and spot.	Continue	VMRC - A		Must be coordinated with VIMS and ODU
4. Habitat and water quality issues	3.2 MD & PRFC will encourage research. VA will continue to fund stock assessment research.	Continue	MDNR - A		Additional research endeavors will require funding. Needs to be coordinated with universities and other agencies.
			PRFC - A		
			VMRC - A		
		Continue	DCFM - A		Requires coordination among agencies
			MDNR - A		
			PFC - A		
			PRFC - A		
			VMRC - A		

Legend:

DCFM = District of Columbia, Fisheries Management
MDNR = Maryland Department of Natural Resources
PRC = Pennsylvania Fish Commission
PRFC = Potomac River Fisheries Commission
VMRC = Virginia Marine Resources Commission

A = Administrative action
R = Regulation

ODU = Old Dominion University
VIMS = Virginia Institute of Marine Science

